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Editorial

Questions of Ethics

This issue of the *Bulletin* is almost completely devoted to the interfaith hearings on nuclear power which concluded November 30. Many people will share the ambivalent feelings expressed by Peter Stevens-Guille about CNS participation. It is certainly interesting to speculate on what a Martian, recently landed in Ontario, would make of the procedure. Our notional Martian might observe that following the tragic events in Mexico, when at least 300 people were killed in a series of gas explosions, it would seem not unreasonable that the ethics and morality of that particular energy system might be reviewed. Or, having consulted newspaper files and observed the mortality record of offshore drilling operations, perhaps that specific aspect of the energy picture were undergoing ethical review.

But Martian eyebrows (or equivalent) might rise at the news that the energy system with the least cost in human lives was the one being examined.

While there is the temptation for those of us in the nuclear business to give our spleens some healthy exercise in condemning what seems to be a uniquely (pathologically?) unbalanced approach to the evaluation of one area of scientific and engineering endeavour in isolation, there is the point to be made that exercises like the interfaith hearings provide us with the opportunity to inform and educate.

If the result of CNS participation in the hearings is that the interfaith panel become more aware of some of the scientific and engineering realities of nuclear energy, and can view those realities in the context of a world that is far from "perfectly safe" and in which almost every human action or inaction has some calculable negative side effect, then the exercise will have been worthwhile.

Perspective

Observations on the Canadian Nuclear Program from the Canadian Nuclear Society

The following is an abridged version of the CNS brief to the Interfaith Program for Public Awareness of Nuclear Issues (IPPANI) during the first week of hearings, on "Canada's Domestic Nuclear Issues." Presentation was October 29, 1984 by John Hewitt and Peter Stevens-Guille in Toronto.

Introduction

The Canadian Nuclear Society is a voluntary organization of men and women who apply their intellectual talents to the advancement of nuclear science and engineering in the service of human endeavour.

The CNS attracts largely professionals to its membership, and therefore ethical values engendered through the professional associations are intrinsic to the CNS organization. However, the CNS is not itself a professional association with a government-issued mandate to regulate professional practice. Moreover, while the CNS provides services to its members — largely in relation to professional preparedness — the CNS is not a social or economic self-interest organization.

Rather, the CNS is patterned in the great tradition of learned or scientific societies which has been sustained since the Renaissance, having been born out of the need to advance free scientific thought in a world dominated by dogma.

The success of science itself, and its service to society, owes much to the perseverance of these societies through the ages. It is generally held that the establishment of true scientific fact and the understanding of the physical world simply could not have progressed without the scientific *process* (as distinct from scientific *method*), which strives to preserve scientific integrity through peer review following formal presentation of scientific argument.

Following in this tradition, the CNS sponsors numerous conferences and edits published proceedings containing scientific papers on subjects of technical and social significance in the nuclear field.

The professional backgrounds of CNS members comprise scientific disciplines such as physics, chemistry, biology, most of the engineering disciplines and various technological specialties. The unifying force that brings them together in the CNS is their common involvement, in varied ways, in the development of nuclear science and its applications in the interest of human betterment.

The main objectives of this brief are to respond to the issues raised by the hearing organizers and to convey an impression of how these issues may be viewed by individuals (such as CNS members) who are intimately involved in the science and engineering of creating and maintaining Canada's nuclear facilities and responsibly

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integrating them into the fabric of industrial society.

Achievements

While the technical successes of Canada's nuclear program are well recorded elsewhere, a brief review of some of these and the role of the nuclear professionals in achieving them is appropriate.

The successful development and application of Canada's own nuclear power plant design, CANDU, is undoubtedly the most visible achievement. With a professional team a fraction of the size in other countries, Canada has produced a nuclear power system which, on the basis of overall performance, is the best in the world. The scientists and engineers involved share, with skilled Canadian craftspersons, most of the credit for this success.

A fact often missed is that Canada is *the* leader in the use of radioisotopes for medical purposes. About two-thirds of the Cobalt-60 cancer therapy units used throughout the world were designed and built in Canada. Similarly, Canada is in the forefront of the development and application of food preservation by radiation, a technology that could benefit tens of millions of people.

Science, Religion and Society

Over the centuries there have been numerous confrontations between the churches and the scientific community. This is unfortunate because each, in its way, has been seeking after an understanding of the universe and man's place in it. Traditionally, each has failed to understand the other. Although science theoretically accepts only those postulates that can be experimentally verified, in practice scientists and engineers make assumptions and accept as "laws" relations which are not absolutely proven. In a somewhat analogous manner, articles of religious faith are constantly being re-examined to determine their continued validity.

Judging from the questions posed for this hearing, the underlying problem does not appear to be the disagreement between religion and science, but rather a lack of confidence by the religious community (and perhaps by much of society) in the decision-making process on the use of science (and thereby, perhaps inadvertently, in the scientific community itself).

Comments on the Questions Posed

A general observation can be made on the set of questions. Several suggest a surprising lack of awareness of the political structure and governmental decision-making process in this country. This is surprising since representatives of the faith groups involved are, or should be, cognizant of our political system and, in particular, of the distinction between roles of government officials in public service and elected ministers of the Crown.

Others imply a basic misconception of science and engineering. As alluded to earlier, science, as one part of man's quest to understand the universe, and engineering as the application of that science in the interest of mankind, are but two examples of man's use of his God-given intellectual capabilities. The pursuit of science and its application cannot realistically be turned off, nor, within the principle of responsible stewardship of the gifts given to us, should it be.

With that preamble, the following are some comments on the questions in Appendix A of the convening circular.

Q. 1(a) "Is nuclear energy qualitatively different, from a moral and ethical viewpoint, from all other energy sources?"

This question, which appears to underlie all of the questions, implies an unfortunate misunderstanding, or deliberate misrepresentation. It appears that the writers used "nuclear energy" to mean that energy released by the nuclear phenomena of fission, fusion, or transformation, as contrasted to chemical energy produced, for example, by the burning of coal, or kinetic energy derived, for example, from moving water. Nuclear fission, the source of the energy utilized in nuclear power plants, is a natural phenomenon. As such, it is just one manifestation of the forces in the universe around us, and is neither moral nor immoral, neither ethical or unethical. Only the applications or uses of this phenomenon — of this particular source of energy — can be judged to be moral or immoral.

Without a clear understanding of the above there can be no progress towards resolving the issues and concerns that led to these hearings.

Q. 1(b) "How are decisions made about the scale and balance among future energy sources in Canada and the impact of that balance on future generations"?

Q. 3. "How are decisions made in this field?"

(a) "Who makes decisions in the various nuclear areas?"

(b) "Who has access to this decision-making process?"

(e) "Who speaks for future generations?"

(f) "Who holds the decision-makers accountable?"

These questions which all concern the decision-making process overlap or are closely related. They imply a lack of understanding of the nuclear industry in Canada, an unawareness of the political decision-making process, an unspoken wish to be part of this process, or all three. Although the CNS as an organization is not part of the decision-making process for nuclear policy, some of our members in the course of their work have input to the development of policies and to the resultant projects and activities.

Looking at nuclear power plants, which appear to be the focus of most of the expressed concerns, all in Canada are owned by provincial electrical utilities which in turn are owned by the people of the provinces concerned. The utilities are in effect governed by the elected representatives of the provincial governments. The decisions to build the nuclear power plants have been taken by these elected governments. Similarly nuclear policy at the federal level, pertaining to uranium exports, safeguards, safety regulation, research and, in some cases, financing, has been decided by the government made up of representatives duly elected by the citizens of the country.

Thus, all of the important policy decisions related to the Canadian nuclear program have been made by our elected representatives. It is their duty and instinct to always consider the best interests of the country and its citizens. As elected representatives they are open and subject to pressures and inputs from any part of society. The many controls and conditions imposed on the development of uranium mining in Saskatchewan are an example of how governments respond to the many, often conflicting, viewpoints and pressures.

In the particular case of concern for future generations, special recognition has been given to this obligation. Safety objectives endorsed by the regulatory agency, the AECB, specifically call for consideration of future generations.

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CNS provides Canadians interested in nuclear energy with a forum for technical discussion. For membership information, contact the CNS office, a member of the Council, or local branch executive. Membership fee is $30.00 annually, ($5.00 to students).

La SNC procure aux Canadiens intéressés à l'énergie nucléaire un forum où ils peuvent participer à des discussions de nature technique. Pour tous renseignements concernant les inscriptions, veuillez bien entrer en contact avec le bureau de la SNC, les membres du Conseil ou les responsables locaux. La cotisation annuelle est de $30.00 ($5.00 pour les étudiants).

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Many of the scientists and engineers associated with the CNS are involved in meticulous studies to ensure the full understanding of all of the factors in using underground repositories for long-term storage of radioactive waste. The industry has sponsored studies and seminars on this and related issues, with particular emphasis on possible effects in the future. We are not aware of any other field of activity in which as much attention has been devoted to future effects as in the nuclear field, despite the fact that many other activities have as great or greater potential for negative impact in the future.

The nuclear community has been a pioneer in examining, prior to implementing a project, the potential negative effects, preceding by decades the "environmental" movement of the 70's, as can be seen by reports from the 50's, some of which were written by current members of our Society.

Q. 2(a) "How uncertain is the scientific basis of decision-making in the nuclear field?"

(b) "Does decision-making in this field adequately reflect the scientific uncertainty?"

(c) "Is adequate attention being given to the task of decreasing the uncertainty?"

Nuclear energy and its application have probably a better scientific base than any other technological activity. All aspects have been studied extensively, both domestically and internationally, and there is widespread exchange of information, especially pertaining to health, safety or environmental effects. As a comparative example, much more is known about the effects of low levels of radiation than of typical environmental levels of SO_2.

Despite this scientific thoroughness, it is typical, as noted above, in nuclear design and application, to anticipate that failures may occur and to include features to control or accommodate any possible failure.

Continued research provides ever more knowledge of the behaviour of materials, equipment, systems, and of the humans involved, in an effort to reduce further what small scientific uncertainty remains, if deemed necessary. There is a limit in uncertainty reduction beyond which little marginal protection is achieved. For example, uncertainty on the effects of low-level radiation is unimportant when the levels in question are of the same magnitude as the fluctuations in the natural environmental radiation.

Q. 2(d) "Are there areas of scientific consensus where a significant portion of the public is misinformed?"

If the question were construed as implying that the nuclear scientific community deliberately misinforms the public, then the question would be an affront to the members of that community. The essence of the scientific approach is objectivity, openness, and peer judgements. In scientific process, a new postulate is examined against measurements and observations, its consistency with well-founded postulates (or "laws"), and its ability to explain a wider set of phenomena than could previous postulates. This is an open process, accessible to all through scientific literature.

If, however, the question implies that a significant portion of the public harbours misconceptions of science, and particularly the technological implications of scientific fact, then the answer is "yes." Despite a continuing effort by the scientific community, especially the nuclear community, to inform the public, there remain widespread misconceptions that, for example, a nuclear reactor can explode like a nuclear bomb, or a miniscule amount of radiation could lead to the evolution of monsters. The scientific community does not, deliberately misinform the public on scientific matters. Unfortunately, the public, or elements within the media purporting to represent the public interest, have sought simple answers to complex questions and, when these could not be given, have either taken licence with the truth or have reported part of the truth with the tone of impending doom. A full generation may pass before society will recover to the point of being able to approach the issues objectively.

Q. 3(c) "What is the role of values and pressures in scientific decision-making with respect to nuclear decisions?"

(d) "Are the moral and ethical aspects of these decisions being given sufficient attention?"

These questions are also ambiguous; what is meant by "scientific decision-making", by "values and pressures"? Conclusions and deductions in science are subjected, as mentioned above, to the scrutiny and questioning of the scientific community. By the very nature of the scientific process this "pressure" is objective, not subjective.

Major engineering decisions are always reviewed independently by other engineers usually more experienced, but always having the qualifications established by their peers through their professional associations. Professional engineers are governed by codes of ethics which place public welfare as the highest priority.

Engineering decisions can have ethical implications. An improperly designed or constructed bridge, for example, could lead to the injury or death of people. In recognition of this, professional associations such as the APEO are under public mandate to make professional engineers responsible for the safety of persons who may be affected by their work. This applies to the engineering or scientific aspects of the work. Professional engineers do not pretend to be solely responsible for the social and economic effects of projects in which they are involved although generally they endeavour to see that such evaluations are done.

Q. 4. "Can large-scale, centralized technologies like today's CANDU stations co-exist with a participatory society?"

This obviously leading question invokes one of the principles expounded by the World Council of Churches some years ago in its ideal of the Just, Participatory and Sustainable Society. Without refuting or abandoning these concepts the WCC Church and Society Newsletter for Autumn 1984 notes that, "The role of the WCC is not to perpetuate the same ideas...during the next few years Church and Society will devote much of its attention to environmental ethics and the whole notion of the integrity of creation...". In this sense, as noted earlier, nuclear phenomena are part of creation and logically should be employed, as appropriate, for the benefit of mankind. Since a case can be made that nuclear power is at least as environmentally benign as any source of electricity, and that electricity will continue as a valued energy currency in much of the world, it would likely be acceptable under the suggested broader criteria.

Where nuclear power plants, CANDU or otherwise, are employed by publicly owned utilities, subject to the control and policies of democratically elected governments, and aimed at providing electricity to all citizens at the lowest feasible price, it would appear that they could be considered as meeting the intent of the "participatory" concept. The process of decision-making will weigh heavily on our democratic institutions. The hope for optimal decisions is bolstered only through assurances that all parties involved take care to neither understate nor overstate the scientific assessment of the risks involved.

Q. 5. "How does one calculate the overall financial and societal costs as opposed to the overall benefits of nuclear technology?"

Techniques have been developed in recent years for conducting "social-economic impact analyses," such as those included in the guidelines used by the federal government. However the social and economic models and theories which are employed are much less proven than those in the physical sciences. Accordingly, these evaluations are the weakest and most uncertain input to the overall decision-making process for any major project or program, nuclear or otherwise. They should be applied with due caution.

Now that we have large scale nuclear technology in place, both in regard to nuclear electricity and nuclear medicine, the calculation of financial and social costs should be relatively straightforward, as should evaluating the benefits. A wide choice of yardsticks is available including, GNP, balance of payments, life-style, general wealth of individuals, personal freedom, deprived livelihood, community resettlement, extended or reduced life expectancy, reliability, financial requirements, etc. To yield meaningful results, the same yardsticks must be applied equally to mutually exclusive or alternative decisions.

A well informed public that can provide

majority support for official decisions is essential to the legislative process itself and for general health and satisfaction within society. All sectors of society, including the professional and learned societies, must find the means for more effective and accurate communication with the public. The introduction of nuclear technology, like the introduction of another technology or a social device (such as tax law), is a societal response to identified human need on an unprecedented scale and under socio-economic conditions. For the vast majority, the ensuing changes are for the better and free most of us to participate in our own destinies. Unfettered change, however, may adversely affect some members of society and it is a challenge to our political institutions to minimize adverse effects. The challenges are perplexing, but human society must find ways to cope through affirmation of objectives and preseverence. It would be the greatest of tragedies if (to paraphrase Bronowski) human society should lose its nerve and retreat from knowledge, just as it is on the point of fulfilling a semblance of the inspired prophecies of old.

The Moral and Ethical Dilemma of Nuclear Technology: Is Faith the Critical Ingredient?

The following is contributed by Dr. Jatin S. Nathwani of Ontario Hydro.

The hearings organized by the Interfaith Program on Public Awareness of Nuclear Issues (IPPANI) to identify the moral and ethical issues of nuclear technology concluded the first week of hearings of Canada's Domestic Nuclear Issues on November 2. The program is sponsored by the Toronto Jewish Community, the Anglican Diocese, the Roman Catholic Archdiocese, the Toronto Conference of the United Church and the Baha'i Community of Canada. The panelists, a body of prominent Canadians who have demonstrated an interest in matters of public and social responsibility, inspire a degree of trust rarely observed in public life. The rules of the proceedings, rigorously adhered to, were fair. The austere setting at the Holy Rosary Parish Hall — no plush carpets, hard-backed chairs, coffee and tea in plastic cups — presented an enviable opportunity to the audience, approximately twenty to thirty individuals, to concentrate on the essence of the issue. One can only await, with keen interest, the report of all panelists after the final week of hearings.

As well as the proponents and the uncommitted, there were present those opposed to nuclear technology. I wish to examine the role and contributions of the opponents. Moral and ethical considerations, in my view, require a closer examination of the positions articulated by them.

There are, amongst the opponents, those who have serious misgivings about nuclear technology. These are individuals who come from communities which have borne the brunt, at least in terms of their perceptions, of poorly managed nuclear enterprises 30 to 40 years ago. Their experiences with the failings of social and institutional mechanisms of controls in the past suggest that there is little room for apathy or self-congratulation on the part of the proponents of nuclear technology. Their perceived concerns have a legitimacy which requires prompt, specific actions and not apologies. These specific concerns, however, do not address the larger questions related to the moral and ethical considerations of future use of nuclear technology. I propose, therefore, to focus my examination on the role of a different group whose objections to nuclear technology stem primarily from value-laden or ideological considerations.

In this group there are those who argue that all, or most, of our present ills in society flow automatically from the nature and use of nuclear technology; and that the central predicament of our times can only be resolved by abandoning participation in any uranium-based technological endeavour. Implied here is also the suggestion that this be done quickly.

In support of this view an image is presented of a complex, unmanageable and unforgiving technology with serious potential for widespread loss of life and ill health. This is compounded with an image of secretive, uncaring, irresponsible technocrats without moral scruples, motivated only by a relentless determination and narrow vested interests. It is an image projected of a group of men who have, by their expertise assumed a disproportionate control of the levers of power in society, and whose actions are portrayed as wreaking untold havoc upon many, including yet unborn generations. The image provokes notions of impending catastrophies which have not come to pass only because of sheer luck: the certainty of realisation of unmitigated darkness and irreversible global disaster being only a matter of time.

Goethe's Mephistopheles, in the second part of Faust, observes cynically, but perhaps accurately that, "in the end we are all dependent on monsters of our own creation." That this image of a monstrous technological endeavour has become the essential driving force for groups against nuclear technology is not surprising. It is less surprising since there is available to an impartial observer substantial evidence which provides little solace to the positions put forward by these opponents. The image, therefore, requires to be replenished continually, and with ever increasing stridency. Applied to a specific group, such as nuclear scientists and engineers, it is seriously overdrawn: a caricature rather than a reflection of reality as its exists; misleading and unfruitful as basis for evaluating policy options.

Significant benefits have resulted from a safe and responsible application of nuclear technology. The widespread and increasing application of this technology in medicine, for therapeutic as well as diagnostic purposes, provides a reduction in suffering and ill-health unparalleled in recent history. The technology is at a threshold for significantly increasing the world's supply of food by reducing losses due to spoilage. The benefits of generation of electrical power continue to accrue to all members of society. Overall, the benefits are widely shared, not only by proponents of the technology but also by ordinary people all over the world. The detriment implicit in realization of these benefits is not "zero", but it is relatively low, and of a more situation-specific nature. These considerations suggest to me that in its diverse manifestations, nuclear technology conforms, at least in part, to the distributive principles of social injustice based on the precept of the "larger common good". Since the benefits do not accrue simply to a narrow vested interest, the moral and ethical implications of *abandoning* this technology would have to be examined rigorously and openly.

I suggested earlier that evidence related to substantial benefits of nuclear technology exists and that from the perspective of a practical human endeavour, it is safe. This position is not accepted by the opponents. The spectre of large accidents or unknowable effects of low-level ionizing radiation continues to plague the debate.

But a large body of scientific data for the assessment of the detrimental effects of ionizing radiation has been generated by non-governmental, impartial agencies, such as the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the International Committee on Radiological Protection (ICRP), the U.S. National Academy of Sciences, the World Health Organization (WHO), and the U.S. National Cancer Institute. Recommendations based on assessments of these data are enforced by national regulatory bodies all over the world. These data and the basis of recommendations are continually revised and updated to better reflect the most advanced state of knowledge, its interpretations and an open acknowledgement of inherent uncertainties.

The opponents question the bases of these national regulations and prefer to cite alarming but undefined increases in incidence of

cancer. They quote avidly and uncritically, sometimes from scientific reports and studies; often times from unverifiable sources. Since generation of fear is a primary objective, the image of invisible, penetrating low-level radiation causing long-term ill health amongst large population groups, is an effective vehicle. For example, the practice of strict adherence to internationally accepted nuclear safety standards by the industry are, in the words of one of the opponents, a "complicity to murder". This is not just hyperbole, but also a deliberate attempt to reinforce the image of a demonic technology and evil intentions.

Every legitimate scientific uncertainty is exploited to its fullest effect to support certain prevailing fallacies. For those whose opposition is based fundamentally on ideological considerations, these fallacies must prevail despite experience, despite statistics, despite our increased sensitivity to the recognition of those issues not strictly within the realm of true scientific inquiry. The fallacies prevail because in a certain sense they are cheering: they reduce anxieties to a hysterical self-pity and provide an attention-seeking device; in my view, ostentatious and disproportionate. It recognizes no moral and ethical propriety of discussion in a public forum.

As the famous eighteenth century philosopher, David Hume, in his "Inquiry Concerning the Principles of Morals," had so aptly noted, "...when (one) bestows on any man the epithets of *vicious* or *odious* or *depraved*, he then speaks another language (other than that of self-love), and expresses sentiments in which he expects all his audience are to concur with him. He must here...depart from his private and particular situation, and must choose a point of view, common to him and others." It would appear that if we are to resolve difficult public policy issues in an open forum and in a democratic manner, there are reasonable ethical limits and responsibilities incumbent upon those participating. Perhaps the time has now come to shed the anger, begin to trust one's opponents, to seek consensus, to revitalize the faith in reason and the democratic process and begin the arduous task of seeking agreement over what does not constitute the essence of the truth. These hearings may very well represent a watershed: an opportunity to contemplate one of the most divisive issue of our times.

J.S. Nathwani

FYI

Ontario Reactor Update (Ontario Hydro)

Unit 6 at the Bruce Nuclear Power Development successfully completed its commissioning tests in August and was declared commercially in-service September 14, four months ahead of the targeted startup date.

Also at the Bruce site in August, garter spring repositioning was completed on Unit 5. Startup of the unit occurred November 15.

At Pickering, the end of summer brought to successful completion the garter spring repositioning on Unit 7, which started up October 22. And at Pickering Unit 8, garter spring repositioning is underway.

Retubing of Pickering Units 1 and 2 began in November, with a reactor mock up aiding the program. Work at Pickering 1 is ahead of schedule. All west feeder pipes have been disconnected from endfittings, and radiation exposures are lower than predicted.

London Nuclear Defends CAN-DECON (Staff)

London Nuclear Ltd. has defended its CAN-DECON dilute chemical decontamination process against findings by the US Electric Power Research Institute (EPRI) that it can cause stress cracking in steel under extreme (BWR) test conditions. Earlier this year, EPRI exposed uncorroded stainless steel to the CAN-DECON solution for 500 hours prior to being stressed to 1,000 pounds per square inch until fracture. The steel exhibited intergranular stress corrosion more quickly than unexposed steel under these exaggereated conditions.

London Nuclear notes that many different methods of testing for such cracking by researchers in several countries have shown that CAN-DECON has no effect on piping beyond what normally occurs in nuclear reactor systems and that the few extreme EPRI tests under laboratory conditions do not nullify the large body of satisfactory CAN-DECON decontaminations performed on reactor systems with no deleterious effects. In actual decontamination, normally no part of the plant is exposed for longer than 24 hours. Also, on-going examination of samples of steel in several nuclear plants treated with CAN-DECON shows no deleterious effects. Exposure limits to the 0.1% acidic CAN-DECON solution are expected to be determined soon.

ANS Source Term Committee Reports (ANS)

A consistent and careful review of recently available data from extensive engineering and scientific investigations, which were undertaken in the aftermath of the 1979 Three Mile Island accident, shows that the amount of radioactivity that could be released in a severe reactor accident is far less than had been estimated earlier. This finding is the result of the work of a special committee chartered by the American Nuclear Society to review and report on the current state of knowledge concerning source terms — estimates of the amounts and types of radioactivity available for release to the environment in postulated severe reactor accidents. These are accidents in which enough fuel damage occurs to permit the escape of substantial amounts of fission products from the reactor coolant system *and* the containment is breached substantially beyond its design-basis leakage. Specifically, the committee found that reductions in the source term from estimates reported in the 1975 pioneering Reactor Safety Study (WASH-1400) could range from more than a factor of 10 to several factors of 10 for the critical fission products in most of the accident scenarios that have been recently considered. This finding is based on considerable technical progress since 1975 in both fundamental knowledge and analytical techniques.

The important factors that had been neglected or inadequately treated in earlier analyses were the chemical reactions, the aerosol formation, and depletion processes that occur as a natural consequence of the inherent properties of the materials and the accident environment. These reactions and processes result in a large retention of radioactivity in the reactor coolant system and the containment, and thus effect a large decrease in leakage of radioactivity to the environment.

In addition, early containment breach from rapid pressure surges or explosions was found to be sufficiently improbable to warrant its neglect as a significant contributor to source terms. It was also found that containment systems were more resistant to delayed breaching from slow overpressure and overtemperature then previously estimated.

ICSU Concludes Nuclear Waste Disposal is Safe (Science)

The International Council of Scientific Unions (ICSU) has concluded that nuclear wastes may be safely disposed of using current technology. The international scientists which formed the ICSU steering committee (Chaired by J.M. Harrison, a Canadian geologist) and working groups reflected the prestigious and highly knowledgeable range of national academies and scientific unions forming the ICSU membership.

ICSU saw nuclear wastes as hazardous for at least 10^5 years and viewed the International Commission on Radiological Protection system of dose limitations as a rational system. They agreed that high level wastes should be stored for 50 to 100 years before disposal to reduce the problem of thermal loading of the disposal site.

The 19 recommendations of the ICSU working groups include:

- More effort is needed to ensure safe storage of HLW for 50-100 years.
- Development of underground laboratories in proposed host rocks should be accelerated.
- Specialists in the formation of recent geological deposits should be involved in HLW research.
- Mining methods and technologies should be studied.

- Seabed disposal (via sedimentary subduction) should be analyzed.
- More research is required on radionuclide migration, concentration and speciation in the environment.

The full reports are available from ICSU, 51 Boulevard de Montmorency, 75016 Paris, France.

AECL Lab For Indonesia

(Stephen Salaff)

Atomic Energy of Canada Ltd. (AECL) has received a letter of intent to open negotiations for the supply of a nuclear research laboratory to Badan Tenaga Atom Nasional (BATAN), the National Atomic Energy Agency of Indonesia. The nuclear mechano-electronic laboratory, scheduled for construction at the Puspitek research complex near Jakarta, will consist of five buildings including a computer centre. The project is valued at approximately US $30 million, and will extend over three and one-half years.

If the negotiations with BATAN can be successfully completed, the Puspitek nuclear laboratory would be the first one marketed by AECL. The Crown Corporation bested major nuclear technology suppliers from France, West Germany, Italy and the United States in securing Jakarta's letter of intent.

The Puspitek laboratory will pursue research in the following fields of nuclear science: medicine, health and safety, and reactor technology and instrumentation. These disciplines have been chosen to assist Indonesia in developing and implementing a nuclear power program.

Three AECL operating divisions will participate in the Puspitek project. These are CANDU Operations (project management and procurement), the Research Co. (conceptual design engineering and most of the training), and the Radiochemical Co. (supply of equipment for the cyclotron to be housed in the laboratory, and some training). In addition, a number of Canadian private sector manufacturers will supply equipment for the Puspitek project.

Fusion Blanket Program Launched

(AECL)

Work has begun at Chalk River Nuclear Laboratories on a three-year program in solid breeder materials for fusion reactors. The program will be jointly funded by the Canadian Fusion Fuels Technology Project (CFFTP) and AECL Research Company on a 70-30 per cent cost-sharing basis, for a total of approximately $5 million.

Neutrons from the fusion reaction will interact with lithium atoms to produce tritium in a region outside the fusion chamber, but enveloping it like a blanket. The Chalk River research program will concentrate on the materials aspects of this fusion blanket.

The new proposal follows the completion of a three-phase, one-year study of fusion breeder blanket technology, by a Chalk River team under contract to CFFTP with co-funding from AECL Research Company. The main objective of the program is to establish a Canadian presence in the international fusion breeder blanket field and to ensure complete coverage of the fusion cycle by CFFTP. A secondary objective is to prepare the technology and expertise required for enhanced tritium production in CANDU reactors, should this be required for future Canadian tritium sales for fusion applications.

CNS Branch Programs

Toronto Branch

The CNS Toronto Branch opened its 1984-85 season on September 13 with a presentation entitled "The History and Prospects of Food Irradiation" by Mr. Frank Warland, Senior Vice-President of AECL Radiochemical Company. Mr. Warland optimistically predicted that we will be eating irradiated food within the next 5 years. The push for irradiation is on, particularly for spices, which are currently processed with ethylene oxide gas now suspected of causing deleterious health effects. Other prime markets include elimination of salmonella bacteria in poultry, restriction of fruit fly damage in various fruits and treatment of sewage waste from international airports.

Irradiation using a Co-60 gamma ray source may occur in either a permanent or a mobile irradiation unit. Required doses range from 15 krad, which will prevent sprouting in potatoes, to more than 1000 krad for complete sterilization of the product. Costs for irradiation processing are approximately $40-70/ton for poultry and $3-6/ton for spices.

On October 24, Mr. Atila Csik, Radiation Safety Officer at the Royal Victoria Hospital in Montreal, provided us with a thought-provoking presentation about responsibility associated with nuclear accidents, referring to industrial diagnostic and medical uses of radioisotopes. Mr. Csik described incidents involving implanted treatment sources left in patients and several incidents in which gammography sources had been lost and later found by unsuspecting workers, causing their premature deaths. The recent Mexican disaster at Juarez was discussed at length — an old piece of machinery, which turned out to be a forgotten Co-60 therapy unit, was damaged on the way to the scrapyard resulting in the release of radioactive Co-60 pellets. In this accident, some of the radioactive cobalt ended up in a Mexican steel mill where the contaminated steel was processed into reinforcing building rods and restaurant table legs, some of which were later found in a restaurant in Winnipeg. Mr. Csik emphasized the need for responsibility and public accountability, saying that public trust must be earned. He also felt that open investigations should be held following incidents of these types in order to determine how the failure occurred and how to avoid similar problems in the future.

The presentation stimulated much discussion afterwards about personal radiation detectors, psychological effects of nuclear radiation and the role of the media in communicating nuclear issues.

Eva Hampton
John Marczak

CNS News

The Agreement of Cooperation Between the Canadian Nuclear Society and the Chinese Nuclear Society

The following is the text of the CNS/CNS agreement negotiated in June, and signed November 19, 1984 at University of Toronto.

The Canadian Nuclear Society (based in Toronto) and the Chinese Nuclear Society (based in Beijing), proceeding from the desire of the scientific and technical personnel in the two countries to enhance mutual understanding and promote scientific and technological exchange and cooperation between the two societies, have reached through friendly consultation the following agreement:

CNS-CNS Agreement Signed

Signing the Agreement of Cooperation Between the Canadian Nuclear Society and the Chinese Nuclear Society are (left) J.S. Hewitt, Immediate Past President of the Canadian Nuclear Society and Jiang Shengjie, President of the Chinese Nuclear Society. Six signatories from the two societies signed November 19, 1984 at University of Toronto. The agreement was negotiated in June 1984 during presidency of Dr. Hewitt.

Article I
The present agreement is aimed at developing friendly exchanges and cooperation between the two societies and also promoting the development of peaceful nuclear science and technology:

Article II
All privileges identified or agreed to shall be reciprocal between both societies;

Article III
Each society agrees to:

1. *Promote the establishment of contacts with members of the other society for the purpose of exchanging information and experience.*
2. *Assist in facilitating exchange visits for the purpose of cooperation and information on aspects of nuclear science and technology.*
3. *Encourage the interchange of technical information, journals and periodicals which are jointly identified by the executive officers of each society.*
4. *Inform the other, in advance of sponsored conferences and meetings of international significance, and also to charge no basic registration fee for three official representatives who have preregistered.*
5. *Other undertakings to expand exchanges and cooperation as may be agreed from time to time.*

Article IV
This agreement shall come into effect for three years from the date of signature and shall be reviewed and extended at three year intervals. This agreement is subject to a six month notice of cancellation by either society. Amendments to this agreement may be made at any time subject to approval by the executive of both societies.

Article V
Neither society shall be liable for any expense in connection with this agreement, except by prior arrangements and written agreements.

Article VI
This agreement is made in duplicate in Chinese and English; both texts being equally authentic.

(Signed) *On behalf of the Canadian Nuclear Society: J.S. Hewitt, President; J. Howieson, for P.D. Stevens-Guille, 1st Vice-President; J.A. Weller, General Manager.*
(Signed) *On behalf of the Chinese Nuclear Society: Jiang Shengjie, President; Zhao Renkai; Xu Honggui, CNS Deputy Secretary-General.* Date: June, 1984.

Conferences & Meetings

International ANS/ENS Topical Meeting on Probabilistic Safety Methods and Applications

Sponsored by the American Nuclear Society, co-sponsored by the Canadian Nuclear Society et al., to be held **February 24 - March 1, 1985**, in San Francisco, California. For information contact: **Ian B. Wall, Electric Power Research Institute, P.O. Box 10412, Palo Alto, California 94303.**

International Symposium on Food Irradiation Processing

Sponsored by the International Atomic Energy Agency and UN FAO, to be held **March 4-8, 1985** in Washington, DC. For information contact: **Conference Service Section, IAEA, P.O. Box 100, A-1400 Vienna, Austria.**

Seminar on Speciation of Fission Products in the Environment

Sponsored by the Commission of the European Communities, to be held **April 16-19, 1985** in Oxford, UK. For information contact: **Speciation-85 Secretariat, Room C1.23, c/o National Radiological Protection Board, Chilton, Didcot OX11 ORQ, Oxfordshire, UK.**

11th Simulation Symposium on Reactor Dynamics and Plant Control — Call for Papers

Sponsored by the CNS Nuclear Science and Engineering Division, to be held **April 22-23, 1985** in Kingston, Ontario. The scope of the symposium covers all aspects of nuclear power plant modelling and simulation. Its main objective is to promote free discussion on unresolved problems and on methods under development. 300 word abstracts are due before **February 1, 1985.** Authors will be notified about the acceptance of their summaries by **February 22, 1985**. To allow distribution of papers to participants, full papers, each with a maximum of 30 pages (8-1/2 x 11 inches), should be sent before **March 22, 1985**. For information contact: **Hugues Bonin, Dept. of Chemistry & Chemical Engineering, Royal Military College, Kingston, Ontario, K7L 2W3.**

Second National Topical Meeting on Tritium Technology in Fission, Fusion and Isotopic Applications

Sponsored by American Nuclear Society and co-sponsored by Canadian Nuclear Society, to be held **April 30 - May 2, 1985** in Dayton, Ohio. For information contact: **T. Drolet, Canadian Fusion Fuels Technology Project, 2700 Lakeshore Rd. W., Mississauga, Ontario, L5J 1K3.**

CNS 6th Annual Conference — Call for Papers

The Sixth Annual Conference of the Canadian Nuclear Society will be held in Ottawa, Ontario, Canada, in parallel with the Canadian Nuclear Association's 25th Annual International Conference, **June 2-5, 1985.**

Papers are invited on all subjects relating to applications of nuclear technology, both technical and socio-economic, including Thermal hydraulics, Reactor Physics, Fuel Cycles, Risk Assessment, Safety Analysis, Regulatory Aspects, Nuclear Plant Design and Operation, Radiation Protection and Health Physics, Isotopes and Radiation, Food Preservation, and Other Applications of Nuclear Technology. *A special invitation is extended for authors to present research*

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and development results in new reactor applications, fusion, applications of accelerators, and areas of advanced technology. Sessions are also being planned on regulatory issues, plant operations and pressure tube integrity.

Persons wishing to present a paper are requested to submit a summary, postmarked no later than **January 7, 1985.** Summaries should include an introductory statement indicating the purpose of the work and a closing statement summarizing the significant new results. The principal author will be notified of the status of the summary on or about **February 25, 1985.** Summaries and full papers will be published in the language of the author (English or French only). Authors whose summaries have been accepted will be required to submit a full paper (in prescribed format on mats to be provided, not to exceed 7 mats in length) no later than **June 5, 1985,** for publication in the Conference Proceedings. For further information contact: **P.M. French, 1985 CNS Annual Conference, c/o Atomic Energy Control Board, P.O. Box 1046, Ottawa, Canada, K1P 5S9.**

Canadian Radiation Protection Association Annual Meeting

To be held **June 11-13, 1985** in Saint John, NB. For information contact: **John Paciga, NBEPC, Point Lepreau Generating Station, P.O. Box 10, Lepreau, NB, E0G 2H0.**

International Topical Meeting on Computer Applications for Nuclear Power Plant Operation and Control

Sponsored by American Nuclear Society, co-sponsored by Canadian Nuclear Society and European Nuclear Society, to be held **September 8-12, 1985** in Pasco, Washington. For information contact: **Technical Program Chairman Alan E. Waltar, P.O. Box 1970, Richland, Wash. 99352;** or **Lino Magagna, Ontario Hydro, 700 University Ave., Toronto, Ontario, M5G 1X6.**

International Topical Meeting on High Level Nuclear Waste Disposal

Sponsored by the American Nuclear Society, co-sponsored by Canadian Nuclear Society, to be held **September 24-26, 1985** in Pasco, Washington. For information contact: **Dr. H.C. Burkholder, Battelle, Pacific Northwest Laboratory, P.O. Box 999, Richland, WA 99352.**

3rd Workshop on Analytical Chemistry Related to Canada's Nuclear Industry — Call for Participants

Sponsored by CNS, CNA, Chemical Institute of Canada, AECL, et al., to be held **October 20-23, 1985** in Kimberley, Ontario. Contributions to informal discussion groups should deal with problems and current work, of future plans and projects. Abstracts of subject of discussion are due **June 3, 1985.** For information contact: **Dr. A. Guest, Ontario Hydro, A7 All, 700 University Ave., Toronto, Ontario, M5G 1X6.**

The Unfashionable Side

Strictly for the Birds

The recent sensational CBC radio documentary *Spies in the Sky — The Canadian Connection* — has triggered a major controversy in Canadian ornithological and diplomatic circles. Claims that Canadian participation in international ornithological research projects is making a direct contribution to developments in avian military applications have yet to be satisfactorily refuted.

A recent statement from the federal Wildlife Ministry emphasized that Canadian ornithological research is, and has always been, "solely for peaceful purposes," but this has been hotly disputed by Professor Armitage Loathing, Head of Aphasia University's Department of Underwater Ornithology, and the consulting producer for the CBC program. "There is simply no way you can isolate so called "peaceful" research from military programs" Professor Loathing noted at a news conference held last week at Aphasia University's student pub, the "Stuffed Parrot." "Remember," Professor Loathing argued, "That seemingly innocent research into seagulls' food recognition abilities was used by the British in World War One in a program to train seagulls to perch on U-boat periscopes." (Professor Loathing added that the only reason this program was not pursued subsequently was that it was found difficult to get a glue that would firmly attach dead fish to U-boat periscopes).

More recent military applications of ornithological research cited by Professor Loathing included:

- Work on migration patterns of Canadian geese applied to a CIA sponsored high-altitude photo-reconnaissance project, involving the installation of special long-focal length sub-miniature cameras on "over 1000" geese.
- A study of the social habits of crows taken over by the Pentagon and applied to the training of attack squadrons of these birds for counter-insurgency work.

Additionally, Professor Loathing charged that both the Audubon Society and the World Wildlife Fund were "heavily subsidized" by funds from US weapons research laboratories. Calling for an immediate moratorium on Canadian participation in any international ornithological research programs, Professor Loathing said "We've got to stop lending Canadian expertise to the development of ever more sophisticated military applications of avian research, and we've got to stop now."

Ernest Worthing